

**Sept. 20, 1960**

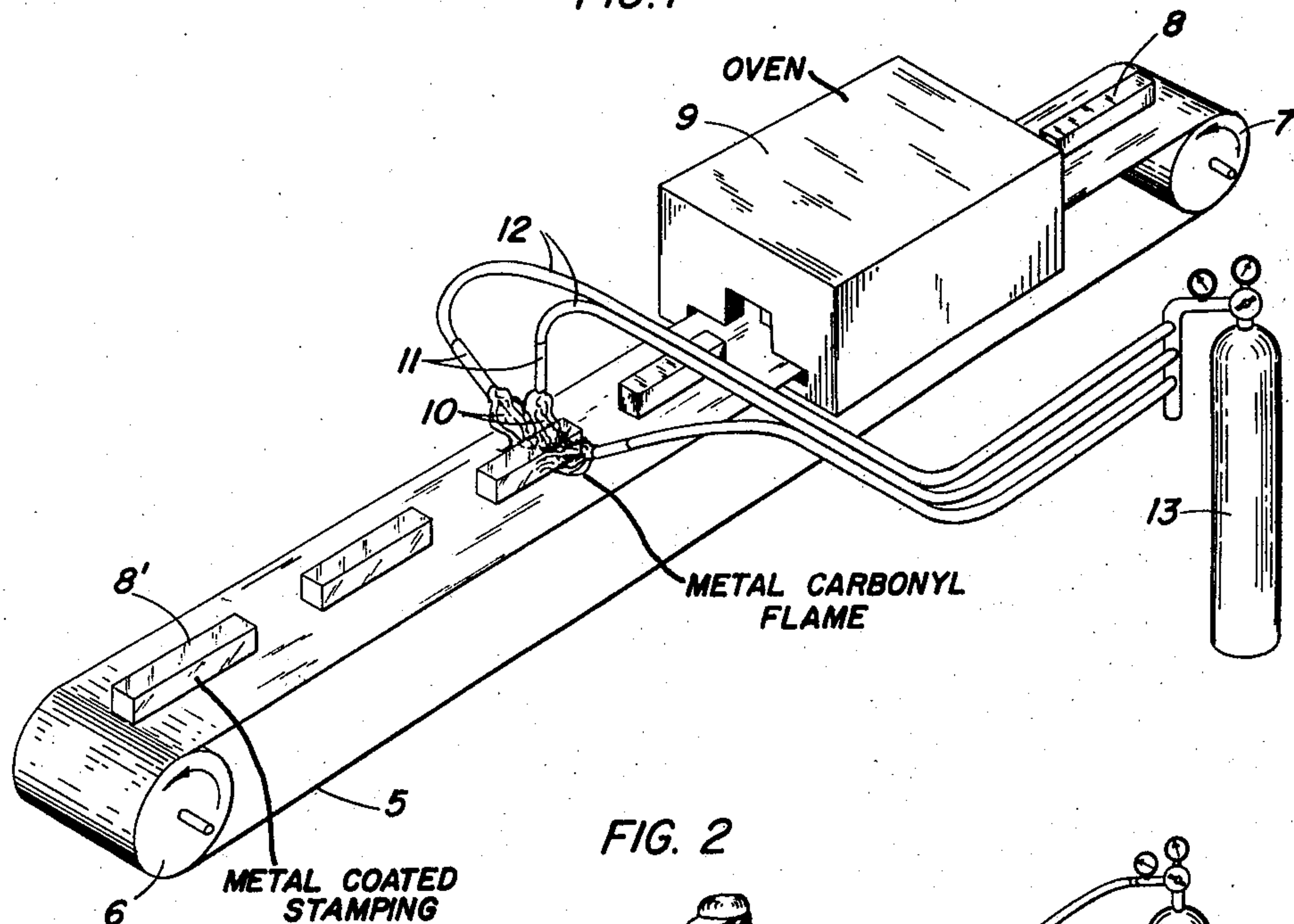
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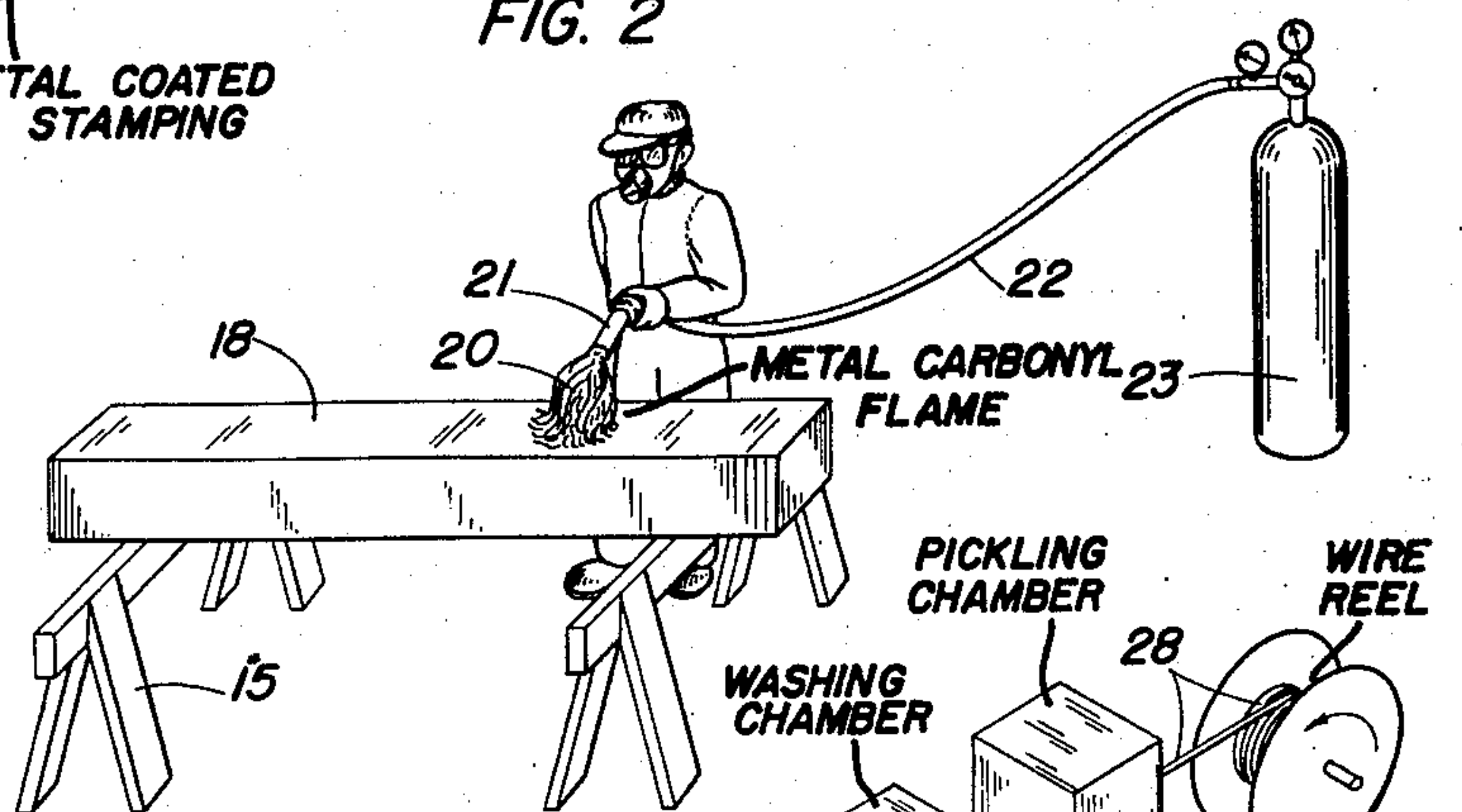
# METHOD OF COATING METALLIC ARTICLES WITH METAL

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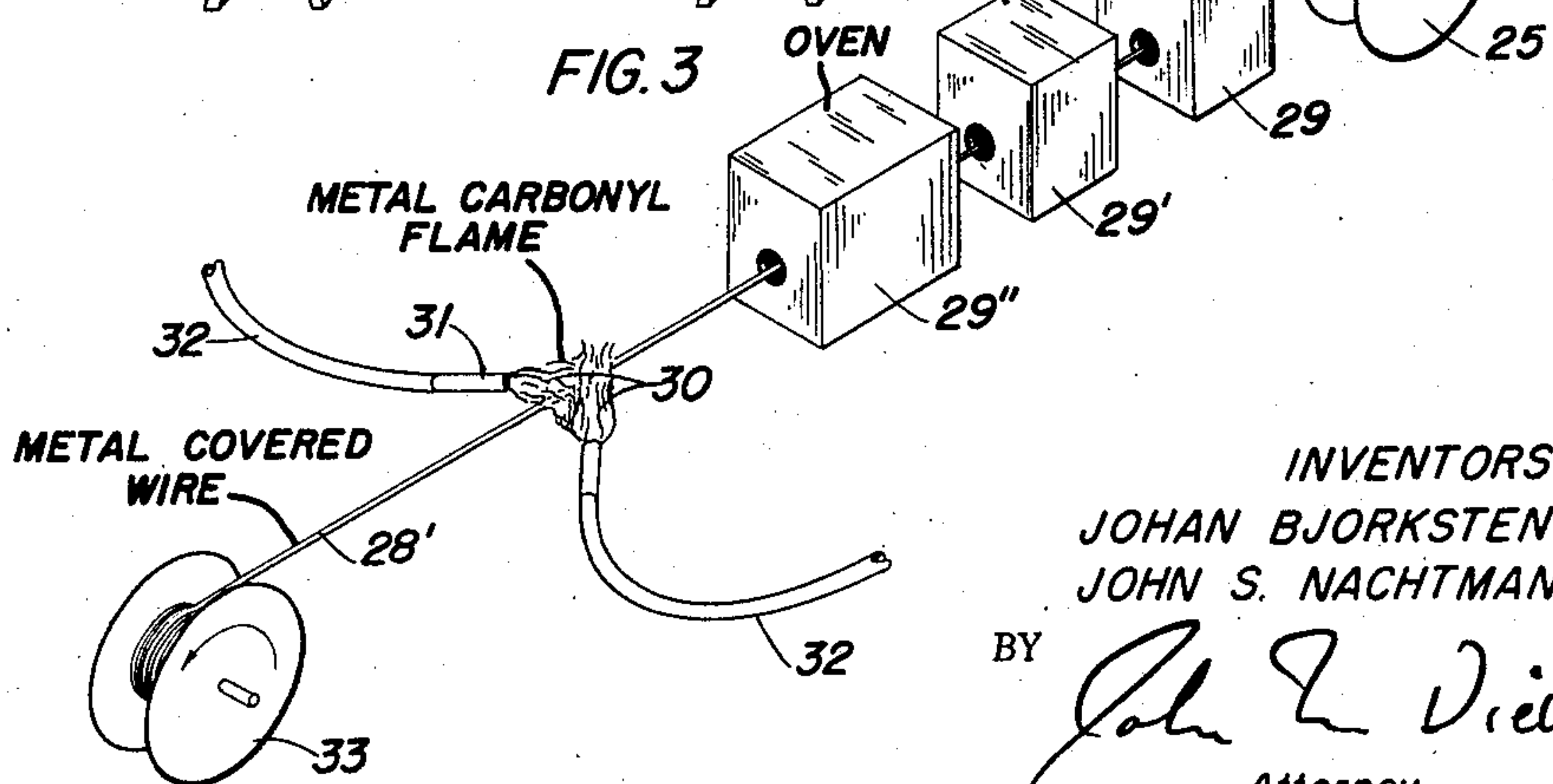
**FIG. 1**



**FIG. 2**



**FIG. 3**



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## METHOD OF COATING METALLIC ARTICLES WITH METAL

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8 Claims. (Cl. 117—46)

This invention relates to a process for providing coatings of metal on articles of metal such as metal wire, strip and sheet metal castings and metal stampings in accordance with discoveries stemming from the invention described and claimed in co-pending application Serial Number 382,518, filed September 28, 1953, entitled Method for Metal Coating Glass Surfaces at Higher Speeds now abandoned, of which the instant application is a continuation-in-part.

In the aforesaid application, there is described a process wherein glass fibers and other ceramic fibers drawn from a bushing can be coated with a uniform adherent coating of metal at very high speeds such as 1,000 to 10,000 feet per minute or more by drawing such fibers from a bushing and passing them while still containing the heat from the molten mass within said bushing through a flame of burning metal carbonyl. In accordance with the instant invention a like process is utilized to provide uniform and adherent metal coatings with great rapidity on metal articles which are preferably preheated to a temperature of at least about 300° F.

It is therefore an object of the invention to provide metal coatings on metal articles.

Another object is a process for providing metal coatings on metal articles with relatively great rapidity and uniformity by passing the metal articles through a burning metal carbonyl flame.

Other objects will become apparent from the drawings and from the following detailed description in which it is intended to illustrate the applicability of the invention without thereby limiting its scope to less than that of all equivalents which will be apparent to one skilled in the art. In the figures, like reference numerals refer to like parts and:

Figure 1 is a perspective view showing the application of the process to a series of shaped articles carried by a conveyor belt;

Figure 2 is a perspective view showing the application of the process to a stationary shaped metal article; and

Figure 3 is a perspective view showing the application of the process to a continuously moving metal wire.

Referring now to Figure 1, there is shown a conveyor belt 5 extending around two rollers 6 and 7. Belt 5 carries on its upper surface a plurality of shaped metal articles 8 which, for example, may be steel stampings. Steel stampings 8 are first carried by conveyor 5 through furnace or oven 9 wherein they are preferably preheated to a temperature of at least 300° F. They then pass through flame 10 issuing from burners 11 supplied by tubes 12 from container 13 with a gaseous metal carbonyl such as iron carbonyl, nickel carbonyl or the like. The articles as they pass out from under the flames and are allowed to cool on the belt as shown at 8' are suitably coated with a coating of metal corresponding to the metal of said carbonyl, i.e., iron or nickel, nickel being preferred in the case of steel stamping.

As shown in Figure 2, a steel casting 18 which has been preheated to a temperature of preferably at least 300° F.

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is supported on any suitable supporting means 15. A flame 20 issuing from burner 21 is then passed over the article, the burner 21 being supplied with gaseous metal carbonyl through tubing 22 from container 23.

It is desirable to provide ventilating means, not shown, to protect operators and personnel in the area from inhalation of metal carbonyl (which in the unburnt form is very poisonous) which may have been incompletely burned and to protect them from particles of metal which may be suspended in the air as combustion products, but the very extensive precautions which need to be taken in normal circumstances when utilizing metal carbonyls need not be used in the present instance since combustion of the metal carbonyl causes oxidation of the carbonyl to corresponding metal and oxides of carbon with the results that the combustion products are relatively non-poisonous.

Referring now to Figure 3, metallic wire 28 may be unreel from supporting reel 25 and then be pickled in any conventional manner by pickling means 29, then cleaned by any suitable washing means at 29' and then passed through oven or furnace 29'' wherein it may be preheated to a temperature of at least 300° F. It may thence pass through flames 30 issuing from burners 31 supplied with gaseous metal carbonyl through tubing 32 from any suitable source. The carbonyl mixes with atmospheric air and undergoes combustion with oxygen of the air that issues from the burner and the wire is passed through flame fronts of the flames, just as in the embodiments of Figures 1 and 2 metal articles are caused to pass through such flame fronts or the flame fronts are caused to pass over the article. As the result of passing through said flames, the wire as at 28' is coated with a metallic coating of the metal corresponding to the gaseous metal carbonyl supplied to the burners and is then reeled and wound up on reel 33.

The shaped articles, such as castings, stampings, strip, sheet or wire which are coated according to the invention may be of any metal such as iron, nickel, copper, brass, bronze, aluminum or the like. Suitable coatings may be obtained with any carbonyl which may be supplied in gaseous form and caused to burn with oxygen. As described in the aforementioned application, the result is believed to be due to a decomposition during combustion into chemically extremely active and short-lived compounds i.e., free radicals which further decompose to deposit metal from the carbonyl on the metal of the article being coated. Metals of which the carbonyl may be used include, for example, cobalt, nickel, molybdenum, tungsten, iron and chromium; others may be used.

In order to control the rate of reaction or thickness of coating, we may, rather than using undiluted carbonyl, dilute the carbonyl with an inert carrier or diluting gas such as nitrogen, helium, neon, argon or the like and although we generally prefer to use at least 10% of gaseous carbonyl to 90% of inert gas we may use as little as 1% of gaseous carbonyl to 99% of inert gas and we may use 100% carbonyl, utilizing no inert gas.

As an example, in accordance with the invention a steel stamping such as a part for a stapling machine or an automotive part is first pickled in hydrochloric acid then washed in hot water, allowed to dry and then placed in a spray booth. The stamping is heated to a very dull cherry red by directing a flame of acetylene torch at it and is then coated with a bright and adherent coating of nickel by directing at the article while still at such temperature a flame of gaseous metal carbonyl issuing from a burner tube 3/8" in diameter supplied with a gas comprising 30% nickel carbonyl and 70% nitrogen, the flame being passed back and forth over the article in the manner of a paint spray gun. Likewise, an alu-



minum casting is preheated to 350° F. in an oven, then placed in a spray booth and coated with nickel in the same way.

It is thus seen that the invention is broad in scope and is not to be restricted excepting by the claims in which it is our intention to cover all novelty inherent in the invention as broadly as possible in view of prior art.

Having thus disclosed our invention, we claim:

1. The process of coating a metallic article with a metal which comprises the steps of preheating said metal article to a temperature of at least 300° F. and then causing the flame of burning gaseous metal carbonyl in an oxygen containing gas to impinge on the article.

2. The method of coating elongated metallic bodies with metal which comprises preheating said bodies to a temperature of at least 300° F. and then passing them through flames of burning gaseous metal carbonyl in an oxygen containing gas while at such temperature.

3. The process of coating a metallic wire with a metal which comprises heating said wire to a temperature of at least 300° F. and then passing the wire through flames of burning gaseous metal carbonyl in an oxygen containing gas, while at such temperatures.

4. The process of continuously coating a metallic wire with a metal which comprises continuously advancing a

metallic wire, continuously applying heat to a zonal portion of said advancing wire to raise the temperature thereof to at least 300° F., then causing said wire to pass through at least one flame front of a flame of burning gaseous metal carbonyl in an oxygen containing gas while at such temperature.

5. The process of claim 1, wherein said metallic article is metallic plate.

6. The process of claim 1, wherein said metallic article is metallic sheet.

7. The process of claim 1, wherein said metallic article is metallic rod.

8. The process of claim 1, wherein said metallic article is metallic wire.

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